

Unit I

Introduction to Quality & Software Quality

SYLLABUS

Weightage : 15 Marks

Introduction to Quality

Historical Perspective of Quality, What is Quality? (Is it a fact or perception?), Definitions of Quality, Core Components of Quality, Quality View, Financial Aspect of Quality, Customers, Suppliers and Processes, Total Quality Management (TQM), Quality Principles of Total Quality Management, Quality Management Through Statistical Process Control, Quality Management Through Cultural Changes, Continual (Continuous) Improvement Cycle, Quality in Different Areas, Benchmarking and Metrics, Problem Solving Techniques, Problem Solving Software Tools.

Software Quality

Introduction, Constraints of Software Product Quality Assessment, Customer is a King, Quality and Productivity Relationship, Requirements of a Product, Organisation Culture, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Problematic Areas of Software Development Life Cycle, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.

INTRODUCTION TO QUALITY

Q.1 Describe the historical perspective of Quality briefly.

OR

How did the quality improvement concept evolved over time?

Ans.:

- The field of quality and quality improvement has its root in agriculture. Early efforts of quality improvement in agriculture may be attributed to the statistical research conducted in Britain, in early 20th century, to assist farmers regarding crop cultivation plans while maintaining the soil quality.
- This work inspired Walter Shewhart at Bell Laboratories to develop Quality Improvement programs for products to reduce the cost to customer without affecting profitability of manufacture.
- His changes motivated Dr. Edward Deming to implement improvement programs to improve quality and he invented and demonstrated his ideas of 'Total Quality Management' in Japan.
- Japanese producers fully embraced quality improvement methodologies and started to integrate the concepts of 'Total Quality Management' in their industries.
- During last few decades, they successfully utilized quality tools and TQM methodologies and became a leading nation in manufacturing and supplying a vast array of electronics, automotive and other products in the entire world.
- Quality of Japanese products stems from the systematic organization and understanding of processes used in all aspects of product development, and introduction of tools and methodologies that permit monitoring and understanding about what is happening in different processes of manufacturing and management of interactions of those processes.
- Japanese quality improvement programs created the sets of interrelated processes which assure the same product quality in repetitive manner in larger number to satisfy the demand of a huge market.
- Defects are analyzed and root causes of those are identified and eliminated through continual process improvement.
- This has helped in optimizing the processes to produce better results in repetitive manner.

Q.2 What is quality? (Is it a Fact or Perception)

Ans.:

- Though it is an important question but doesn't not have a simple answer. Some people define it as a fact while others define it as a perception of customer/user.
- The quality of a product is often said to be shortlist or selection of the best among the same products. There may not be a complete idea about the meaning of quality or what we are looking for while selecting a product, if the reason for choosing one product over the other is questioned.
- The term quality means different things to different people at different times, different places for different products.
- For example, to some users, quality may be no/less defects and works exactly as expected and matches with his/her concept of cost and delivery schedule. Such a thought may be a definition of Quality- "Quality is fitness for use".

- Quality can also be defined as 'Conformance to specifications', defining it as an attribute of product which satisfies/exceeds the customer's expectations.
- Some believe that quality is a judgment or perception of the customer/user about the attributes of a product. Others believe that quality means delivering products that,
 - (a) Meet and fulfill customer's needs which include expressed needs and implied requirements derived by system analysts and business analysts.
 - (b) Meet customer standards, either as defined by the customer or by the normal usage or by the national or international bodies.
 - (c) Meet expected and unexpected future needs and aspirations of customers.
- Others may simply ignore these definitions of quality and say, "I will know the quality of a product when I see it". It seems that all 'know' or 'feel' somehow what the meaning of quality is, though it is very difficult to put it in exact words.
- Something that fulfills/exceeds customer's preconceived ideas about the quality is likely to be called as a quality product.

Q.3 Define 'Quality' as viewed by different stakeholders of software development and usage.

Ans.: Following definitions describe different perceptions toward quality of products :

- 1. Customer-Based definition of quality :**
 - (a) Quality product must have 'Fitness for use' and must meet customer needs, expectations and help in achieving customer satisfaction and possibly customer delight.
 - (b) Any product can be considered as a quality product if it satisfies its purpose of existence through customer satisfaction.
 - (c) This approach gives the definition of - "Quality is fitness for use".
- 2. Manufacturing-Based definition of quality :**
 - (a) This definition is mainly derived from engineering product manufacturing.
 - (b) It is not expected that the customer knows all requirements of the product, and many product level requirements are defined by architects and designers on the basis of customer feedback /survey.
 - (c) A quality product must have a definition of requirement specifications, design specifications etc. i.e. the product must conform to these specifications.
 - (d) This approach gives the definition of 'Conformance to specifications/ requirements'.
- 3. Product-Based definition of quality :**
 - (a) The product must have something that other similar products do not have which can help the customer satisfy his/her needs in a better way.
 - (b) It is distinguishable from similar products in market and customer appreciates the product in comparison to competing products.
 - (c) Also, the customers must feel proud of owning it due to its inherent attributes and characteristics.
- 4. Value-Based definition of quality :**
 - (a) A product is the best combination of price and features or attributes expected by the customers.
 - (b) The customer must get value for his investment by buying the product.

- (c) The cost of a product has direct relationship with the value for his investment by buying the product.
- (d) Many a times it is claimed that 'People do not buy products, they buy benefits'.

5. Transcendent quality :

To many users/customers, it is not clear what is meant by a 'Quality product/, but as per their perception it is something good and they may want to purchase it because of some quality present/absent in the product.

Q.4 What are the core components of quality? Explain in Details.

OR

Explain some of the postulates of quality.

Ans.: 1. Quality is based on customer satisfaction by acquiring a product :

- (a) The effect of a quality product, delivered and used by a customer, on his satisfaction and delight is the most important factor in determining whether the quality has been achieved or not.
- (b) It may come through many factors such as attributes of a product, time required for a customer to acquire it, expected price to be paid and so on.
- (c) Thus the producer must understand the purpose of a product and then devise a quality plan for it accordingly.

2. The organization must define quality parameters :

- (a) It is difficult for the manufacturer to achieve the quality of product without knowing what customer is looking for while purchasing it.
- (b) If product quality has been is defined in some measurable terms, it can help the manufacturer in deciding whether quality has been achieved or not.
- (c) The cycle of improvement i.e. 'Define', 'Measure', 'Monitor', 'Control', 'Improve' must be followed :
 - **Define** : Characteristics or attributes of product clearly defined.
 - **Measure**: Quantitative measures must be defined.
 - **Monitor** : Monitoring mechanisms, corrective and preventive action plans should be in place.
 - **Control** : Reviewing and controlling procedures to control the product quality must be implemented.
 - **Improve** : Continous/continual improvements necessary to keep the competitors away.

3. Management must lead the organization through improvement efforts :

- (a) Management is the single strongest force existing in an organization to make the changes as expected by a customer.
- (b) Management should lead the endeavor of quality improvement program by defining vision, mission, policies, goals and values and show the existence of the same by self-examples in the organization.
- (c) Management must have quality planning at organization level to support improvement actions.

4. Continuous process improvement is necessary :

- (a) For improving the competitive cost advantage to producer as well as customer, quality must be produced with an aim of first time right and must be improved continuously/continually.

- (b) The first step for producing quality is the definition of processes used for producing the product and the cycle of continuous or continual improvement to refine and redefine processes to achieve targeted improvements.

Q.5 Differentiate between Continuous and Continual Improvement.

Ans.:

	Continuous Improvement	Continual Improvement
1	It is dynamic in nature. The changes are done at every stage and every time to improve further.	It is dynamic as well as static change management. The changes are done, absorbed, baseliner and sustained before taking next step of improvements
2	Continuously striving for excellence gives a continuous improvement	Periodic improvement followed by stabilization process sustenance represents continual improvement.
3	It has a thrust on continuous refinement of the processes to eliminate waste continuously	Stabilization of processes at each iteration of improvement where waste is removed in stages
4	It has high dependence on people having innovative skills tending towards inventions	Less dependence on people and more on innovation process
5	Environment is continuously changed	Changes in environment are followed by stabilization
6	Sometimes it creates a turbulence in an organization ,if people are not able to digest continuous change	It may be better suited than continuous improvement. It gives a chance to settle the change before next change is introduced.

Q.6 Define the term quality and elaborate different views on quality. [A-19]

Ans.: There are different perception towards quality of products :

1. **Customer-based definition of quality** : Quality product must meet customer needs, expectation and satisfaction.
2. **Manufacturing based definition of quality** : It means customer is not fully aware about requirements & requirements are defined by architects designed on feedback survey.
3. **Product-based definition of quality** : Production must add some new appreciable feature on comparison to similar product in the market.
4. **Value-based definition of quality** : A product is the best combination of price and features required by the customers the cost of the product has direct relationship with the value that customer find in it.
5. **Transcendent quality** : It means that customer purchased the product because of specific feature absent/present in the product.

Quality views :

1. **Producer's view** : Meeting requirements is a producer's view of quality. This is the view of the organization responsible for the project and processes, and the products and services acquired, developed, and maintained by those

processes. Meeting requirements means that the person building the product does so in accordance with the requirements. Requirements can be very complete or they can be simple, but they must be defined in a measurable format, so it can be determined whether they have been met. The producer's view of quality has these four characteristics:

- (a) Doing the right thing
- (b) Doing it the right way
- (c) Doing it right the first time
- (d) Doing it on time without exceeding cost

2. Customer's view : Being fit for use is the customer's definition. The customer is the end user of the products or services. Fit for use means that the product or service meets the customer's needs regardless of the product requirements. Of the two definitions of quality, fit for use, is the more important. The customer's view of quality has these characteristics:

- (a) Receiving the right product for their use
- (b) Being satisfied that their needs have been met
- (c) Meeting their expectations
- (d) Being treated with integrity, courtesy and respect

Most Information Technology (IT) groups have two quality gaps: the producer gap and the customer gap. The producer gap is the difference between what is specified (the documented requirements and internal standards) versus what is delivered (what is actually built). The customer gap is the difference between what the producers actually delivered versus what the customer wanted.

3. Provider view : This is the perspective of the organization that delivers the products and services to the customer.

4. Supplier view : This is the perspective of the organization (that may be external to the producer's company, such as an independent vendor) that provides either the producer and/or the provider with products and services needed to meet the requirements of the customer.

Q.7 What are different views of different stakeholders on quality? Discuss in Details.

OR

Define the stakeholders for successful projects at micro level and for successful organizations at macro level.

Ans.: Following are different views of different stakeholders on quality :

1. Customer :

- (a) Customer is the main stakeholder for any product/project because he will be paying for the product to satisfy his requirements.
- (b) Customer's view of quality of product interprets customer requirements and expectation for getting a better product at defined schedule, cost and adequate service along with required functionalities.

2. Supplier :

- (a) Supplier is a development organization in the context of software application development.

(b) Supplier has some expectations, which must be satisfied by producing a product and selling it to customer. It may range from profitability, name in market, repeat orders to customer satisfaction.

3. Employee :

- (a) These people may be permanent/temporary workers but may not be contractual laborers having no stake in product success.
- (b) As the projects/organizations become successful, people working on these projects/in these organizations get more recognition, satisfaction, pride etc.

4. Management :

- (a) Management may be divided further into project management, staff management, senior management, investors etc.
- (b) Management needs more profit, recognition, turnover improvements, etc. to make their vision and mission successful.

5. Society :

- (a) Society suffers as well as benefits due to successful projects/organizations.
- (b) Successful organizations generate more employment, wealth for the people who are in the category of customer, supplier, employee, management etc. It also affects the resource availability at local as well as global level.

6. Government :

- (a) Government may get higher taxes, export benefits, foreign currency etc. from successful projects/organizations.
- (b) There may be some problems in terms of money availability and flow as success leads to more buying power and inflation.

7. Quality perspective of all these stakeholders defines their expectations from projects/organizations. If these views match perfectly and there is no gap in the stakeholder's expectation, then organization performance can be improved significantly as collective efforts from all the stakeholders.

Q.8 Explain the financial aspect of quality.

Ans.:

- People were of the opinion that more price of a product represents better quality involves more inspection, testing, sorting, etc. and ensures that only good parts are supplied to the customer.
- Sales price was defined as

$$\text{Sales price} = \text{Cost of manufacturing} + \text{Cost of quality Profit}$$
- Considering the monopoly, the above approach is good because sales price is decided by the manufacturer depending on three factors.
- Unfortunately since monopoly doesn't exist in real world, in a competitive environment, the equation changes to

$$\text{Profit} = \text{Sales price} - [\text{Cost of manufacturing} + \text{Cost of quality}]$$
- Cost of Manufacturing is a cost required for developing the right product by right method at the first time. The money involved in resources like material, people, licenses, etc., forms a cost of manufacturing. It remains constant for a given project for a given period of time.

- Cost of quality includes all the efforts and cost incurred in prevention of defects ,appraisal of product to find whether it is suitable to customer or not and fixing of defects or failures at various levels as and when they are reported and conducting any retesting, regression testing, etc.
- Profit is the earnings over the sales of the product and finally Sales price is the total cost of the product the customer is required to pay.

Q.9 Describe the terms : Customers, Suppliers and Processes.

Ans.:

- Suppliers are supplying the inputs required and some customers who will be buying the outputs produced.
- Suppliers and customers may be internal or external to the organization.
- External suppliers provide input to the organization and external customers receive the output of the organization.
- In turn, suppliers may be customers from some other organizations and customers may be acting as suppliers for somebody else down the line.
- Internal Customers are the functions and projects serviced and supported by some other functions/projects. System admins may have projects as their customers while purchasing may have system admins as their customers.
- Internal customers need not be directly internal to the company. For instance, you may partner with other companies in order to deliver your product to the end user – the external customer. Such internal customers all have a hand in delivering the product to your end client. Stakeholders and shareholders are additional internal customers, perhaps less obvious but quite significant.
- External Customers are the external people to the organization who will be paying for the services offered by the organization. These are the people who will be actually buying products from the organization.

Q.10 Explain total quality management (TQM).

Ans.:

- Total quality management principle intends to view internal and external customers as well as internal and external suppliers for each process, project and for entire organization as a whole.
- The process and functions of an organization can be broken down into component elements, which can act as suppliers/customers to each other during the workflow.
- Each supplier eventually becomes a customer at some other moment and vice versa.
- Supply chain relationship may be defined graphically as, shown in following figure :



- 'Total quality management' (TQM) is the application of quality principles to all facets and business processes of an organization.
- It is about applying quality methods to the entire organization whether a given function or part of the organization faces external customers or not.
- Dr. Edward Deming implemented quality management system driven by 'Total Quality management' and 'Continual Improvement' in Japanese environment.
- Dr. Deming proposed principles for quality management that are widely used by the quality PR actioners.

Q.11 Describe 'Total Quality management 'principles of continual improvement.

OR

What are the quality principles of Total Quality Management (TQM)? [A-19]

Ans.: 1. **Develop constancy of purpose of definition and deployment of various initiatives :**

Management must create constancy of purpose for products and processes, allocating resources adequately to provide for long term as well as short term needs. The processes followed during entire lifecycle of product development from requirement gathering to final delivery must be consistent with each other over a larger horizon.

2. **Adapting to new philosophy of managing people/stakeholders by building confidence and relationships :**

Management must adapt to the new philosophies of doing work and getting work done from its people and suppliers.

3. **Declare freedom from mass inspection of incoming/produced output :**

There must be an approach for elimination of mass inspection followed by cost of failure as the way to achieve quality of products because mass inspection results into huge cost overrun and product produced is of inferior quality.

4. **Stop awarding of lowest price tag contracts to suppliers :**

Organizations must end the practice of comparing unit purchase price as criteria for awarding contracts. Vendor selection must be done on the basis of total cost including price, rejections, etc. Aim of vendor selection is to minimize total cost, not merely initial cost of purchasing.

5. **Improve every process used for development and testing of product :**

Improve every process of planning, production and service to the customer and other support processes constantly.

6. **Institutionalize training across the organization for all the people :**

An organization must include modern methods of training which may include on-the-job-training, classroom training, self-study etc. for all people to make better use of their capabilities. Skill levels of people can be enhanced to make them suitable for better performance by planning different training programs.

7. **Institutionalize leadership throughout organization at each level :**

An organization must adopt and include leadership at all levels with the aim of helping people to do their jobs in a better way. Their focus must shift from number of work items to be produced to quality of output.

8. Drive out fear of failure from employees :

An organization must encourage effective two-way communication and other means to drive out fear of failure from minds of all employees. Employees can work effectively and more productively to achieve better quality output when there is no fear of failure.

9. Break down barriers between functions/departments :

Physical as well as psychological barriers between departments and staff areas must be broken down to create a force of cohesion. People start performing as a team and there in synergy of group activities.

10. Eliminate exhortations by numbers, goals, targets :

Eliminate use of slogans, posters and exhortations of the work force, demanding 'Zero Defects' and new levels of productivity, without providing methods and guidance about how to achieve it.

11. Eliminate arbitrary numerical targets which are not supported by processes :

Eliminate quotas for work force and numerical goals for managers to be achieved. Substitute the quotas with mentoring and support to people, and helpful leadership in order to achieve continual improvement in quality and productivity of processes.

12. Permit pride of workmanship for employees :

People must feel proud of the work that they are doing, and know how they are contributing to organizational level. This means replacing 'management by objective' to 'management by fact'.

13. Encourage education of new skills and techniques :

Arrange a rigorous program of education and training for people working in different areas and encourage self-improvement programs for everyone. They need to accept new challenges.

14. Top management commitment and action to improve continually :

Clearly define top management's commitment to ever-improving quality and productivity and their obligation to implement quality principles throughout the organization.

Q.12 Describe cultural change requirement for quality improvement.

OR

Describe Dr. Joseph Juran approach of quality management.

OR

Explain the lifecycle of quality improvements.

[A-19]

- Ans.:**
1. Dr. Joseph Juran is a pioneer of statistical quality control with a definition of improvement cycle through (DMMCI) i.e. 'Define', 'Measure', 'Monitor', 'Control', 'Improve'.
 2. One must understand the interrelationships among the customers, suppliers and processes used in development, testing etc. and establish quality management based on metrics program.

3. Following are three parts of the approach, namely :

- (a) **Quality planning at all levels :** Quality planning happens at two levels :
 - **Organization Level :** It must be in the form of policy definition and strategic quality plans on the basis of vision, missions set by senior management.
 - **Unit Level :** Quality planning at unit level must be done by the people responsible for managing the unit. Project plan and quality plan at unit level must be consistent with the strategic quality plans at organization level.
- (b) **Quality control :**
 - Quality control process examines the present product at various levels with the defined standards so that an organization may appraise the outcome of the processes.
 - It must measure the deviations with respect to the number of achievements planned in quality planning to reduce those deviations to minimum.
- (c) **Quality improvement :**
 - Improvement processes attempts to continuously improve the quality of the process used for producing products.
 - There is no end to quality improvements and it needs to take newer challenges again and again.

Q.13 Explain Philip Crosby's approach to quality improvement.

OR

Explain quality management through cultural changes.

- Ans.:**
- 1. Philip Crosby's approach to quality improvement is based on cultural change in an organization towards total quality management.
 - 2. Quality management through cultural change defines quality improvements as a cultural change. It involves the following :
 - (a) An organization must setup working groups like quality circles or quality improvement teams and try to improve awareness about the customer needs, quality and process measurements. It may not be able to improve in all areas at a time and prioritization may be essential depending upon some techniques such as Cost benefit analysis .But it must prioritize the improvements depending upon resources available and efforts required.
 - (b) Introducing teams representing different functions and areas for quality improvement can help in setting the change of culture. Improving quality of the processes of development, testing, managing etc. is a team work led by management directives.
 - (c) Setting goals with reference to customer expectations which may give competitive advantage to the organization in the market. Also, setting measurable goals in each area of organization can help in improving processes at all the levels.
 - (d) Giving recognition to achievers of quality goals will boost their morale and set a positive competition among the teams leading to improvements.
 - (e) Repeating quality improvement cycle continuously by stretching goals further for next phase of improvements is required to maintain and improve the status further.

Q.14 Explain PDCA cycle or continual improvement cycle.

OR

Write a short note on continual improvement cycle.

[A-19]

- Ans.:**
1. Continual (Continuous) improvement cycle is based on systematic sequence of Plan-Do-Check-Act activities representing a never ending cycle of improvements. It was initially implemented in agriculture them later in electronic industry and now it is famous in all industries.
 2. PDCA improvement cycle can be thought of as a wheel of improvement continually(continuously) rolling up the problem-solving and achieving better and better results for organization at each iteration.
 3. Following are the stages of PDCA cycle explained with the help of a diagram

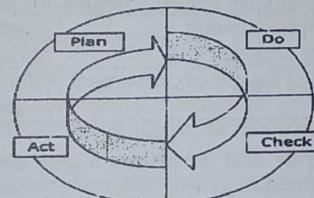


Fig.: Continual improvement cycle (PDCA cycle)

4. Plan :

- (a) Planning includes answering all questions like who, when, what, why, where, how etc. about various activities and setting expectations.
- (b) Expected results must be defined in quantitative terms an actions must be planned to achieve answers to these questions.
- (c) Baseline studies (i.e. where one is standing and vision defines where one wishes to be) are important for planning.

5. Do :

- (a) An organization must work in the direction set by the plan devised in earlier phase for improvement.
- (b) Actual execution of a plan can determine whether the results as expected are achieved or not.
- (c) 'Do' process need inputs like resources, hardware, software, training etc. for execution of a plan.

6. Check :

- (a) An organization must compare the actual outcome of 'Do' stage with reference or expected results which are planned outcomes.
- (b) Expected and actual results must be in numerical terms, and compared at some periodicity as defined in the plan.

7. Act :

- (a) If any deviations are observed in actual outcome with respect to planned results, the organization may need to decide actions to correct the situation.
- (b) One may have to initiate corrective or preventive actions as per the outcome of 'Check' stage.
- (c) When expected results and actual results match with given degree of variation, one can consider that the plan is going in the right direction.

Q.15 Explain quality with respect to different areas.

- Ans.:**
1. Different domains need different quality factors. They may be derived from the customers / users of the domain.
 2. Definition of quality expectations will vary from instance to instance depending on the domain, type of product, type of customer, other competitive products, and their features and so on.
 3. The table below lists different areas representing different domains and indicates some factors that might be considered related to quality in these areas or some common expectations from customers.

Product/Service Category	Expected attributes
Airlines Industry	On time arrival and departure, comfortable journey, low cost service, reliability and safety
Health Care Industry	Correct diagnosis and treatment, minimum wait time, lower cost, safety and security
Food Service Industry	Good product, good taste, fast delivery, good ambience, clean environment
Consumer Products Industry	Properly made to suite individuals , defect free products, cost effective
Military Services	Rapid deployment, decreased wages and cost, security
Automotive Industry	Defect free product, less fuel consumption, more power, safe journey
Communication Industry	Clear communications, faster access and cheaper service

Basic quality parameters by stalwarts of quality management :

1. Cost of the product and value which the customer finds in it.
2. Service offered to the customers, in terms of support by the manufacturer
3. Time required for the delivery of the product.
4. Customer satisfaction derived from functionalities of a product.
5. Number of defects in the product or frequency of failures faced by users.

Q.16 What is Benchmarking in metrics?

- Ans.:**
1. Benchmarking is an important concept used in Quality Function Deployment (QFD).
 2. It is the concept of creating qualitative / quantitative metrics or measurable variables, which can be used to assess product quality on several scales against a benchmark.
 3. Typical variables of benchmarking may include :

(a) Price of a product	(b) Time required to acquire it
(c) Customer satisfaction	(d) Defects or failures
(e) Attributes or features of products	
 4. Metrics are defined for collecting information about product capabilities, process variability and outcome of the process.
 5. An organization must develop consistent set of metrics derived from its strategic business plan and performance of benchmark partner.

Q.17 Explain the types of problem solving techniques.

Ans.: Problem solving can be accomplished by both qualitative and quantitative methods but problem definition becomes easier when we put them against some measures or comparators :

1. Qualitative problem solving technique :

- (a) It refers to understanding a problem using only qualitative indexes such as high, medium, low, etc. depending on whether something is improving or deteriorating from the present status
- (b) This is a typical scenario for low maturity organizations where the problems are much broader and can be classified in different bands very easily.
- (c) For initial stages of improvement, qualitative problem solving is sufficient to get faster results also saves time in defining and measuring data accurately and basic maturity is achieved.

2. Quantitative problem solving technique :

- (a) It requires specification of exact measures in numerical terms such as 'the cost has increased 32.5 % during the last quarter' or 'the time required to produce one product unit is reduced by 32 minutes'.
- (b) For highly matured organizations, quantitative analysis is required for further improvements as basic improvements are already done.
- (c) It must follow the cycle of 'Define', 'Measure', 'Monitor', 'Control' and 'Improve'.
- (d) Measurement of processes and products may need good measuring instruments with high level of accuracy and repeatability.

Q.18 Explain advantages and disadvantages of problem solving software tools.

Ans.: Advantages :

1. Accuracy and speed of the tools is much higher as compared to performing all transactions and calculations manually. Calculations can form the basis for making decisions and hence should be as accurate as possible.
2. Decision support offered by the tool is independent of personal skills and there is least variation from instance to instance.
3. Tools can implement theoretical means of assessing metrics about quality as defined by business law, there is no manual variation.
4. Tools alleviate the hard work required to perform hand or calculator driven computations and give more accurate and faster results.
5. Tools can be integrated with other systems to provide a systematic and highly integrated means of solving problems.

Disadvantages :

1. These programs and tools need training before they can be used. Training incurs cost as well as time. Some tools need specific trainings to understand them and use them.
2. All the software's/hardware are prone for defects and these tools are not exceptions to it. There can be some mistakes while building/using them. Sometimes these mistakes can affect the decisions drastically.

3. Decision has to be taken by human being and not by the tool. Tools may define some options which may be used as guide. Some tools can take decision in the limited range.
4. Tools may mean more cost and time to learn and implement.

Q.19 Differentiate between tools and techniques.

Ans.:

	Tools	Techniques
1	Usage of tool is guided by the technique. Tool is of no use unless technique (to use it) is available.	Technique is independent of any tool.
2	Different techniques may use the same tool to achieve different results.	Same technique may use different tools to achieve the same results.
3	Tool improvement needs technological change.	Technique change can be affected through procedural change.
4	Contribution of tools in improvement is limited.	Contribution of techniques in improvement is important.

Q.20 Define 'User's gap' and 'Producer's gap' and explain how these gaps can be closed effectively.

Ans.:

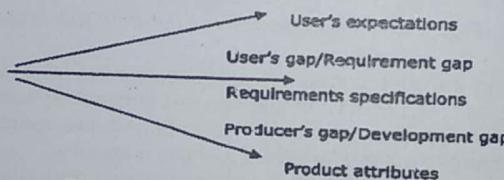


Fig.: User's gap and Producer's gap.

1. **User's gap/requirement gap :**
 - (a) User's gap is a gap between requirement specifications for the product and user expectations from it.
 - (b) The gap focuses on the difference in the final product attributes as defined by requirement statement with respect to the intents of the user.
 - (c) An organization must apply some processes and methods so that the user's gap can be closed effectively and some are methods given below:
 - **Customer Survey :**
 - For a larger market, survey may be conducted by marketing function or business analysts to understand user requirements and collate them into specification document.
 - Survey teams decide present and future requirements for the product and the features required by the potential customers.
 - **Joint Application Development (JAD) :**
 - In JAD, users or customers may be overseeing the system development and closely monitor requirements, architecture, design, coding, testing and test results.
 - It may follow top-down approach where user interfaces and frameworks are developed first and approved by the users and then logic is built behind it.

• User Involvement in application development :

- User may be involved in approving requirement specifications, design specifications, application user interfaces etc.

2. An organization may develop a prototype, mode to understand user requirements and get approval from the user.

3. **Producer's gap/development gap :**

- (a) Producer's gap represents a failure on part of development team to convert requirements into product.
- (b) Producer's gap is due to process failure at producer's place and there must be process improvement plans to close this gap as follows :

• Process Definition :

- Development and testing processes must be sufficiently mature to handle the transfer of information from one stage to another during software development life cycle.

• Work Product Review :

- As the stages of software development life cycle progresses, one may have to keep a close watch on artifacts produced to find any inconsistency.
- Generation of requirement traceability matrix is an important factor in this approach.

Q.21 Describe definition of quality as per Dr. Deming, Dr Juran and Philip Crosby.

Ans.: There are many definitions of quality available in the literature.

1. **Dr Deming's definition of quality :** W. Edwards Deming defined quality as follows :

- Good quality means a predictable degree of uniformity and dependability standard suited to the customer.

2. **Dr Juran definition of quality :** Another frequently used definition comes from Juran :

- Quality is fitness for use.
- This definition stresses the importance of the customer who will use the product.

3. **Philip Crosby definition of quality :** A definition attributed to quality states the following :

- Quality is conformance to requirements.
- The preceding definition assumes that the specifications and requirements have already been developed .The next thing to look for is conformance to these requirements.

Philip Crosby's approach to quality improvement is based on cultural change in an organization towards total quality management.

Quality management through cultural change defines quality improvements as a cultural change It involves the following :

The underlying philosophy of all definitions is the same – consistency of conformance, Performance and keeping the customer in mind.

Q.22 Explain customer's view of quality.

- Ans.:**
- Customer is the main stakeholder for any product/project because he will be paying for the product to satisfy his requirements.
 - Customer's view of quality of product interprets customer requirements and expectation for getting a better product at defined schedule, cost and adequate service along with required functionalities.
 - **Delivering right product :** If customer confirms that the requirements are correct/ not correct, then there is no possibility of further argument about the validity/invalidity of requirements.
 - **Satisfying Customer's needs :** Basic constraint in product development and testing is that product must be capable of satisfying customer's needs. Needs are must among requirements from customer's perspective.
 - **Meeting Customer expectations :** Expectations documented and given formally by the customer are termed as 'expressed requirements' while 'implied expectations' are those which may be expected by customer by default. One must target for 100% conversion of implied into expressed expectations.
 - **Treating every customer with Integrity, courtesy and respect :** Customer telephone calls and mails must be answered with courtesy and in reasonable time. The information provided to the customer must be accurate and he/ she must be able to depend on this information. The customer is not a hindrance to the project development but he is the purpose of the business.

Q.23 Explain supplier's view of quality.

- Ans.:**
1. Supplier is a development organization in the context of software application development.
 2. Supplier has some expectations, which must be satisfied by producing a product and selling it to customer. It may range from profitability, name in market, repeat orders to customer satisfaction .These expectations can be fulfilled in following ways :
 - (a) **Doing the Right Things :**
 - Following right processes to get the product required by the customer and achieving customer satisfaction and profits as well as job satisfaction may be the expectations of a supplier.
 - Suppliers may require clear and correct definitions of deliverables, time schedules etc. to do right things.
 - (b) **Doing it the Right way :**
 - A producer may have his own methods, standards and processes to achieve the desired outputs.
 - Sometimes, customers may impose the processes defined by him for building the product on the producer.
 - (c) **Doing it Right the First Time :**
 - Doing right things at the first time may avoid frustration rework, scarp etc. and improve profitability, reduce cost and improve customer satisfaction for the supplier.
 - Supplier would always like to follow the capable processes which can get the product right at the first attempt.

(d) Doing it on Time :

- If the customer is expected to pay on each milestone, then the producer has to deliver milestones on time to realize money on time.
- Thus doing it on time becomes essential.

Q.24 Define Cost of prevention, Cost of appraisal and Cost of Failure.

OR

Define 'Red money', 'Blue money' and 'green money'.

Ans.: Cost of Prevention :

- An organization may have defined processes, guidelines, standards of development, testing etc. and also define a training program to all people involved in development and testing.
- This may represent a cost of prevention.
- Creation and use of formats, templates, etc. acquiring various process models and standards, etc. also represent cost of prevention.
- This is an investment by the organization and is supposed to give returns.
- This is also termed as 'green money'. It is believed that 1 part of cost of prevention can reduce 10 parts of cost of appraisal and 100 parts of cost of failures.

Cost of Appraisal :

- An organization may perform various levels of reviews and testing to appraise the quality of the product and the process followed.
- The cost incurred in first time reviews and testing is called as the cost of appraisal.
- There is no return on investment but this helps in identifying the process capabilities and process related problems, if any.
- This is termed as 'blue money' as it can be recovered from the customer.
- It is believed that! Part of cost of appraisal can reduce 10 parts of cost of failure.

Cost of Failure :

- Cost of failure starts when there is any defect or violation detected at any stage of development including post-delivery efforts spent on defect fixing.
- An extent of rework, retesting, scrapping etc. represents cost of failure.
- There may be indirect costs such as customer dissatisfaction, no repeat orders, etc. This is termed as 'red money'.
- This cost affects the profitability of the organization badly.

SOFTWARE QUALITY

Q.25 What are the constraints of software requirement specifications?

Ans.: Following are some limitations or constraints of software requirements specifications :

- Software is virtual in nature. Software products cannot be seen, touched or heard. Our normal senses and measuring instruments are not capable of measuring quality of software, which is possible in most of the other engineering products.
- There is a huge communication gap between users of the software and the developers/testers of the product. If an average communication loss of 10% at each stage is considered, then huge distortion is expected from user's perspective of requirements and actual product.
- Software is a product which is unique in nature. Way of software design, coding, and reusability may differ significantly from product to product though requirements may look similar at a global level.
- All the aspects of software cannot be tested fully as number of permutations and combinations for testing all possibilities tend to infinity. Exhaustive testing is neither feasible nor justifiable with respect to cost.
- An application with a problematic code executes wrongly every time it is executed. It makes a very small defect turn into a major one as the probability of defect occurrence is 100% when that part is executed.

Q.26 Justify the statement 'Customer is a King'.

Ans.:

- The customer is the most important person in any process of developing a product and using it including software development.
- All software life cycle processes such as development, testing, maintenance etc. are governed by customer requirements.
- Exceeding customer satisfaction must not be received with surprise by the customer. He must be informed about anything that has been provided except and must be in a position to accept it or reject it.
- A satisfied customer is an important achievement for an organization and is considered as an investment which may pay back in short as well as long term (in terms of references, goodwill, repeat order etc.)
- Satisfied customers may give references to others and come back with repeat orders, such customer references are very important for developing new accounts.

**Q.27 Explain relationship between quality and productivity.
OR**

How the quality and productivity are related with each other? [A-]

Ans.: The quality improvement does not talk about product quality only but a product quality used for making such a product. It will reduce inspection, testing, rework and cost. Thus quality must improve productivity by reducing wastage.

Following are some factors defining quality and productivity relationship :

- 1. Improvement in Quality directly leads to improved productivity.**
Improved quality means improving the processes related to product development.
All the products are the outcome of processes, and good processes must be capable of producing good product at the first instance.
- 2. The Hidden factory producing scrap, rework, sorting, repair and customer complaint is closed.**
Customer does not intend to pay for scrap, rework, sorting etc. to get a good product.
Customer complaints are mostly due to the problems associated with products and aligned services. As this hidden factory producing scrap and wastage stops working, productivity and efficiency improves.
- 3. Effective way to improve productivity is to reduce scrap and rework by improving processes**
Productivity improvement means improving number of good parts produced per unit time and not the parts produced per unit time. It is not hard work but smart work which can help an organization in improving product quality, productivity and customer satisfaction by reducing rework, scrap etc.
- 4. Quality Improvements lead to cost reduction.**
Improvement in quality increases profit margins for producer by reducing the cost of development, cost of quality and reduces sales price for customer. Thus quality implementation must reduce the cost and price without sacrificing profitability.
- 5. Proper communication between management and employee is essential.**
Either there is no communication or there is excessive communication leading to a problematic situation. There are huge losses in communication and distortions leading to miscommunication and wrong interpretation. Thus it is essential that there must be proper communication between employee and management.
- 6. Employees participate and contribute in improvement process.**
In quality improvement program design and implementation, employees perform an important part of identification of problems related to processes and giving suggestions for eliminating them because they are the people doing the actual work.
- 7. Employee shares responsibility for innovation and quality improvement.**
Everyday work can be improved significantly by establishing small teams for improvement which contributes to innovations.

Q.28 Differentiate between Inventions and Innovation.

Ans.:

	Inventions	Innovation
1	Inventions may be accidental in nature. They are generally unplanned.	Innovation is a planned activity leading to changes.
2	Invention may or may not be	Innovations are done by people in a

	acceptable to people doing the work immediately. Inventions are done by scientists and implementation and acceptance by people can be cumbersome as general level of acceptance is very low	team, possibly cross-functional teams, involved in doing a work. There is higher acceptability by people as they are involved in it.
3	Inventions may not be directly applied to everyday work. It may need heavy customization to make it suit for normal usage	Innovations can be applied to every day work easily. The existing methods and processes are improved to eliminate waste
4	Breakthrough changes are possible due to inventions	Changes in small steps are possible by innovation
5	Invention may lead to major changes in technology , way of doing work, etc.	Innovations generally leads to administrative improvements , whereas technological or breakthrough improvements are not possible
6	Inventions may lead to scraping of old technologies , old skills and sometimes, it meets with heavy resistance	Innovation may lead to rearrangement of things but there may not be a fundamental change. It generally works on elimination of waste

Q.29 What are different categories of requirements?

Ans.: Requirements can be put in following different requirements :

1. Stated/Implied Requirements :

- (a) Some requirements are specifically documented in software requirement specifications while few others are implied ones.
- (b) It is also intended not to violate some generally accepted requirements such as 'No spelling mistakes in user interfaces', 'captions on the control must be readable' etc.

2. General / Specific Requirements :

- (a) Some requirements are generic in nature, which are generally accepted for a type of product and for a group of users while some others are very specific for the product under development.
- (b) For example, addition of two numbers should be correct is a generic requirement while the accuracy of 8 digit after decimal and rounding may be a very specific requirement for the application.

3. Present / Future Requirements :

- (a) Present requirements are essential for an application is used in present circumstances while future requirements are for future needs which may be required after some time span.
- (b) "How much future?" must be guided by the customer's vision as this may influence product cost. Some people may use software for 3 years while some other may be planning to use it for 30 years.

On the basis of priority of implementation from user's perspective, requirements may be categorized in following ways:

4. 'Must' and 'Must not' Requirements or Primary Requirements :

- (a) 'Must' requirements are primary requirements for which the customer is going to pay for while acquiring a product. These are essential requirements and the value of the product is defined on the basis of the accomplishments of 'must' requirements.
- (b) These requirements may be denoted by priority 'P1' indicating the highest priority.
- (c) It also covers 'Must not' requirements which must be absent in the product.

5. 'Should be' and 'Should not be' Requirements or Secondary Requirements :

- (a) 'Should be' requirements are the requirements which may be appreciated by the customer if they are present/ absent and may add some value to the product.
- (b) These requirements may be denoted as 'P2' and customer may pay a little bit extra for the satisfaction of these requirements. It also covers 'should not' requirements.

6. 'Could be' and 'Could not be' Requirements or Tertiary Requirements :

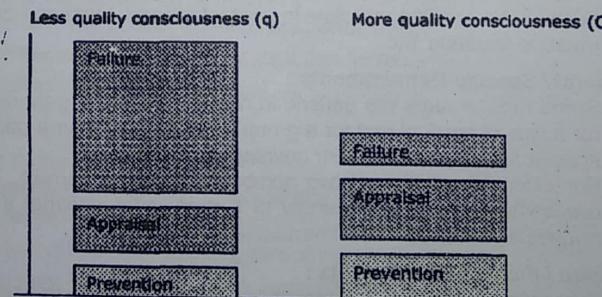
- (a) 'Could be' requirements are requirements which may add a competitive advantage to the product but may not add much value in terms of price paid by a customer.
- (b) These are the lowest priority requirements and can be denoted as 'P3'.
- (c) It also covers 'could not' requirements.

Q.30 Explain the concept of 'q' organizations and 'Q' organizations.

OR

Differentiate between 'Q' organization and 'q' organization.

Ans.:

**'Q' organization :**

1. These organizations believe in listening to customers and determining their requirements.
2. These organizations concentrate on identifying cost of quality and focusing on it to reduce cost of failure which could reduce overall cost and price.
3. Doing things right for the first time and every time is the motto of success.
4. They concentrate on continuous/continual process improvement to eliminate waste and get better output.
5. These organizations believe in taking ownership of processes and defects at

6. They demonstrate leadership and commitment to quality and customer satisfaction.

'q' organizations :

1. These organizations assume that they know the customer requirements.
2. These organizations overlook cost of poor quality and hidden factory effects. They believe in more testing to improve product quality.
3. Doing things again and again to make them right is their way of working. Inspection, rework, scrap etc. are essential.
4. They work on the basis of finding and fixing the problem as and when it is found. One time fix for each problem after it occurs.
5. These organizations try to assign responsibility of defects to someone else.
6. They believe in assigning responsibility for quality to others.

Q.31 Explain characteristics of software.

Ans.: Following are the characteristics of any software :

- Software cannot be sensed by common methods of inspection or testing, as it is virtual in nature. The product is in the form of executable which cannot be checked by any natural method like touch, smell, hearing etc. It cannot be measured by some measuring instruments commonly available like weight, balance, scales etc.
- There are different kinds of software products and their performance, capabilities etc. vary considerably from each other. There are no same products though there may be similar ones or satisfying similar needs. Software is always unique in nature.
- Every condition defined by the software program gets executed in the same way every time when it gets executed. But the number of conditions may be very large tending to infinity and testing of all permutations/combinations is practically impossible.

Q.32 What is SDLC? Explain any two SDLC models in details.

(Select any 2 as per convenience)

Ans.: Software development process defines how the software is being built. There are various approaches to build a software. Following are some of them :

1. Waterfall development approach/ model :

- (a) Waterfall model is the simplest software development model and is used extensively in the development process.
- (b) It is also termed as classical view of software development as it remains the basis or foundation of any development activity.
- (c) Arrows in the waterfall model are unidirectional. It assumes that the developers shall get all requirements from a customer in a single go.
- (d) The requirements are converted into high level as well as low level designs. Design is implemented through coding.

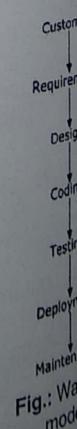


Fig.: Waterfall model.

- 23 (e) Code is integrated and executable is created. Executable is tested as per test plan. The final output in the form of an executable is deployed at customer premises. Future activities are handled through maintenance.

Limitations :

1. There is no feedback loop available in this model.
2. It is assumed that requirements are stable and no problem is encountered during entire development life cycle. Also no rework is involved.

2. Iterative development approach/model :

- (a) Iterative model does not assume that the customer gives all requirements in one go and there is complete stability of requirements.
- (b) It assumes that changes may come from any phase of development to any previous phase and there are multiple permutations and combinations of changes.
- (c) Changes may have a cascading effect where one change may initiate a chain reaction of changes. The above figure shows a feedback loop which is the fundamental difference between waterfall model and iterative development model.

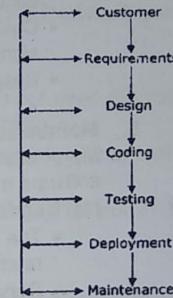


Fig.: Iterative development model.

Limitations:

1. It gives problems in fixed price projects for estimation.
2. Another problem faced by iterative model is that the product architecture and design becomes fragile due to many iterative changes.

3. Incremental development approach/ model :

- (a) Incremental development models are used in developing huge systems. These systems are made of several subsystems which in themselves are individual systems.
- (b) Thus, incremental systems may be considered as a collection of several subsystems.
- (c) These subsystems may be connected to each other externally, either directly or indirectly. A directly interconnected system allows the subsystems to talk with each other while indirectly interconnected system has some application between two subsystems.
- (d) One system may be created and the customer may start using it. The customer can learn the lessons and use them while second part is being developed, giving flexibility to the customer.

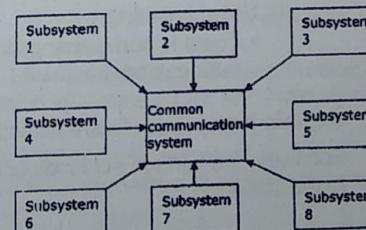


Fig.: Incremental model.

- (e) The above figure shows a common communication system and incremental subsystems.

Limitations :

1. Incremental models with multivendor product integration are major challenge as parameter passing between different systems may be difficult.
2. Increment in the system is followed by heavy regression testing to find that when multiple systems come together, can they work individually as well as collectively.

4. Spiral development approach/model :

- (a) Spiral development process assumes that customer requirements are obtained in multiple iterations, and development also works in iterations.
- (b) Many big software systems are built by spiral models of ever-increasing size.
- (c) First some functionality are added, then product is created and released to customer. After getting the benefits of first iteration of implementation, the customer may add another chunk of requirements to the existing one.
- (d) Further addition of requirements increases the size of the software spirally.
- (e) Sometimes, an individual part developed in stages may act as complete system and it may communicate with the next developed system through some interface.
- (f) In many ERP's, initial development concentrated around material management part which later increased spirally to other parts such as purchasing, sales etc. many banking software also followed as similar route.

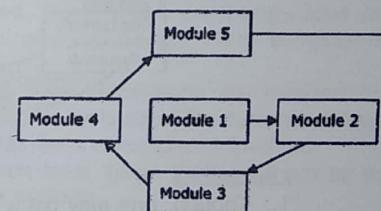


Fig.: Spiral development model.

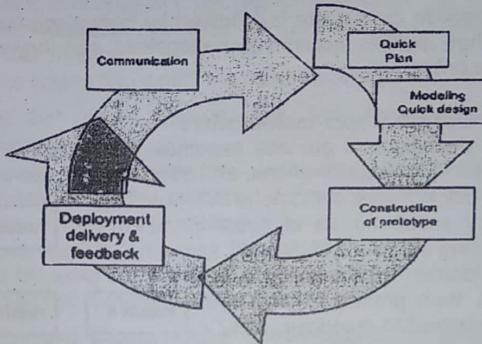
Limitations :

1. Spiral models represent requirement elicitation as the software is being developed.
2. Sometimes, it may lead to refactoring and changes in approach where the initial structures become unusable.

5. Prototyping development approach/model :

- (a) Prototype development approach represents top to bottom reverse integration approach.
- (b) Major problem of software development is procuring and understanding the customer requirements for the product.
- (c) Prototyping is one of the solutions to help in this problem. In Prototyping, initially a prototype of the system is created – this is similar to cardboard model of a building.

- (d) It helps the customer to understand what they can expect from the given set of requirements.
- (e) It also helps the development team to understand the possible application's look and feel.



Limitations :

- 1. Though, one may get a feel of the system by looking at the prototype, one must understand that it is not the actual system but a model.
- 2. The customer may get the feeling that the system is ready and may pressurize development team to deliver it immediately.

6. Rapid application development approach/model :

- (a) Rapid application development is one way to create usable software at a fast speed, and still give an opportunity to the user to understand the development and application being created.
- (b) It is a miniature form of spiral development. Development team may get very less number of requirements for e.g. 5/6.
- (c) They create a design, code it, test it and release it to customer.
- (d) Once customer gets the delivery, he may have a better understanding of his expectations and development process by looking at the product delivered.
- (e) He may add another chunk of requirements and entire development cycle is followed.
- (f) Thus, each iteration will give better understanding about a product being delivered and help in refining the requirements.

Limitations :

- 1. Change in approach and refactoring are the major constraints in RAD.
- 2. It also involves huge cycles of retesting and regression testing. Efforts of integration are huge.

7. Agile development approach/model :

- (a) Agile gives complete freedom to the user to add requirements at any stage of development, and development team has to accept these changes.
- (b) Agile methodologies work on small chunk of work in each iteration and release working software at the end of iteration.

- (c) The main thrust of agile methodologies is complete adaptability to user environment and continuous integration of a product.
- (d) Agile works on the following principles,
 - Individuals and interactions are more important than formal sign-offs for requirements, designs, etc. It concentrates more on 'Fitness for use'.
 - Working software is the outcome of each milestone rather than concentrating on deliverables as defined in the project plans.
 - Customer collaboration is required to get usable software rather than signing various documents for approvals.
 - Responding to changes required by the customer at any moment.

8. Maintenance development approach/ model :

Major cost of the software is in its maintenance. Maintenance activities software may be put under 4 different groups namely :

- (a) **Bug fixing :**
 - The defects present in the given software are fixed. This may involve retesting and regression testing.
 - During bug fixing, analysis of bug is an important consideration.
- (b) **Enhancement :**
 - Here new functionalities are added in the existing software. These functionalities may be required due to changes in the way business is done.
 - Some functionality may be introduced due to changes in user requirements.
- (c) **Porting :**
 - It is where software is taken from older technologies to new technologies. In porting, one is expected to port the functionalities and not the code.
 - Whatever functionalities are available in the old technologies; all those are expected to be present in the new technology.
- (d) **Reengineering :**
 - There is some change in the logic or algorithm used due to changes in business environment.

Q.33 Explain how products are classified on the basis of criticality to the users

Ans.: Following are various schemes of grouping the products on the basis of criticality to the users :

1. Life affecting products :

- (a) Products which directly / indirectly affect human life are considered the most critical products in the world from user's perspective.
- (b) There is an involvement of regulatory and safety requirements.
- (c) This type of product may be further grouped into 5 different categories
 - Any product failure resulting into death of a person. These will be the most critical products as they can affect human life directly.
 - Any product failure which may cause permanent disablement to a patient.
 - Any product failure which may cause temporary disablement.

- Any product failure which may cause minor injury.
- Other products which do not affect health or safety directly.

2. Product affecting huge sum of money :

- (a) A product which has direct relationship with loss of huge sum of money is second in the list of criticality of the product.
- (b) Such products may need large testing efforts and have many regulatory as well statutory requirements.
- (c) E-Commerce and E-Business soft wares may be put in this category.
- (d) Security, confidentiality, and accuracy are some of the important quality factors for such products.

3. Products which can be tested only by simulators :

- (a) Products which cannot be tested in real-life scenario but need simulated environment for testing are third in the ranking o criticality.
- (b) In this case, real life scenario is either impossible to create or may not be economically viable.
- (c) Products used in aeronautics, space research etc. may be put in this category.

4. Other products :

All other products which cannot be categorized in any of the above schemes may be put in this category.

.34 How products are classified depending upon their criticality?

Ans.: 1. Criticality is not an easy term to define. For example, consider auto piloting software where we have three combinations of criticality together. It does affect the life of passengers travelling, cost of an airplane is huge and it cannot be tested in real environment. Thus all the three criticalities come together to make a product most critical.

2. Following are some classifications depending upon the software criticality :

(a) From User's perspective :

- This classification mainly discusses dependency of a business on a system. The criticality may range from complete dependency to no/minimal dependency on the system.
- Product's failure when there is no fallback arrangement available can be very critical from business point of view.
- Product's failure which affects business partially, affecting profitability or service level but can be restored with some efforts and there may be some fallback arrangements.
- Product's failure which does not affect business at all is one of the options, if it fails, one may have another method to achieve the same result.

(b) Environment based perspective of user :

- This classification considers the environment in which the product is operating. It may range from complex user environment to very easy user environment.
- Products where user environment is very complex such as aeronautics, space research etc. may be considered as very critical. As the

environment is very complex, system is already under stress, and failure may add to the situation.

- Products where user environment is comparatively less complex such as banks may represent the second stage of complexity. Huge calculations may be affected, if the system collapses but there may be workaround available.
- Products where user environment is very simple and product failure may not add to the consequences represents the lowest level of complexity.

(c) From Developer's perspective :

- This classification defines the complexity of the system on the basis of development capabilities required.
- Form based software where user inputs are taken and stored in some database and when required, those inputs are manipulated and showed to user on screen as a report represents lowest development complexity.
- If it is algorithm based, where huge calculations are involved and decisions are taken by the system on the basis of the outcome of these calculations, then there is a certain level of complexity involved.
- Artificial intelligent systems which learn things and use them as per circumstances are very complex systems.

Q.35 Identify and discuss problematic areas of software development life cycle.

Ans.: Following are various problematic areas of software development life cycle :

1. Problems with requirement phase :

- (a) Requirements are not easily communicated. Communications is major issue in requirement statement creation and software development.
- (b) Communication of requirement is marked by problems of listening to customer, understanding business domain and usage of language including domain specific terms.
- (c) Requirements change very frequently. Requirements are very dynamic in nature.
- (d) Many times, development teams get confused because customer requirements change continuously. The time gap between requirement definition and actual product delivery also plays a major role in changing requirements.

2. Generally a unique product is developed each time :

- (a) In case of software, no two applications are same, may be similar. The same implementation done by two different developers may differ from each other.
- (b) Even the same program written by the same developer at two different instances may not match exactly. Thus a software product may be unique for that instance.

3. Intangible nature of product, intellectual approach throughout development :

- (a) Software products cannot be felt by normal senses. Its existence can be felt only by disc space it occupies.

- (b) There are multiple approaches possible for implementation of the same set of requirements. Some may feel that one approach is better than the other for different reasons.
- 4. Inspection can be exhaustive / impossible :**
 - (a) Testing of complete software product is practically impossible.
 - (b) It may need huge money and long time to test all possibilities, and still one may not be sure that everything is covered in testing.
- 5. Effect of Bad quality is not known immediately :**
 - (a) Any level of exhaustive testing is not capable of testing each and every algorithm, branch, condition and combination thoroughly.
 - (b) There are some areas which remain untested even after the application is used over extended periods. The effect of this kind of problem and situation during usage may not be known beforehand while deploying the software in use.
- 6. Quality is inbuilt in product :**
 - (a) Quality of a software product cannot be improved by testing it again and finding and fixing the defects.
 - (b) It needs to be built in the product while development using good processes and methods.
- 7. Quality objectives vary from product to product/customer to customer :**
 - (a) Quality objectives are product dependent, time dependent and are mainly driven by customers.
 - (b) For example, in a small computer game for kids, cost may be more important than accuracy. On the contrary, applications developed for aeronautics need to be more accurate while cost factor may not be that important.
 - (c) Degree of importance changes from product to product, customer to customer and situation to situation.

Q.36 List and explain the types of requirements.

Ans.: Following are the types or categories of requirements :

- 1. Technical Requirements :**
 - (a) Technical requirements are about platform, language, operating system, etc. required for the application to work.
 - (b) Selection of technology may be done as directed by the development team. Technical requirements covers whether a standalone or client server or web application type of system.
 - (c) It also talks about configuration of machines, routers, printers etc.
- 2. Economical Requirements :**
 - (a) Economics of software system is dependent on its technical and system requirements.
 - (b) The technical as well as system requirements may be governed by the money that the customer is ready to put in software development, implementation and its use.
 - (c) It is governed by cost benefit analysis.

3. Legal Requirements :

- (a) There are many statutory and regulatory requirements for software product usage.
- (b) For any software application, there may be some rules and regulations by government , regulatory bodies etc. applicable to the business.

4. Operational Requirements :

- (a) Mostly operational requirements are defined by customers or users on the basis of business needs.
- (b) These may be functional or non-functional requirements. Customers tell the development team, what the intended software must do/ must not do when used by the user.

5. System Requirements :

- (a) System requirements including physical / logical requirements are defined by a customer with the help of a development team.
- (b) These include requirements for hardware, machine configurations, types of backup, restoration, physical access control etc.

Q.37 Explain software quality management in details.

Ans.: Quality management involves management of all inputs and processing to the processes defined so that the output from the process is a per defined quality criteria. There are three levels of handling problems, namely.

1. Correction :

- (a) Correction is the condition where defects found in the product or service are immediately sorted and fixed.
- (b) This is a natural phenomenon which occurs when a tester defines any problem found during testing.
- (c) This is mainly quality control approach.

2. Corrective Actions :

- (a) A situation where the root cause analysis of the defects is done and actions are initiated to remove the root causes so that the same defect does not recur in future is termed as corrective action.
- (b) It is a responsibility of operations management group. Generally, project leads are given the responsibilities of initiating corrective actions.
- (c) This is a quality assurance approach.

3. Preventive Actions :

- (a) Preventive action means that there are potential weak areas where defect has not been found till that point, but there exists a probability of finding the defect.
- (b) Generally identification and initiation of preventive actions are a responsibility of senior management. Project managers are given this responsibility.
- (c) This is a quality management approach where an organization takes preventive action to ensure there is no defect in the first place.

I.38 State reasons why software is never defect free.

- Ans.:**
- In case of software development and usage, there are many factors responsible for its success / failure. Few of them are,
 - There are huge communication losses between different entities as requirements get converted into the actual product. Understanding of requirements is a major issue and majority of the defects can be attributed to this.
 - Development people are more confident about their technical capabilities and do not consider that they can make mistakes .Sometimes self-review and/or peer review does not yield any defects.
 - Requirement changes are very dynamic. As the traceability matrix is not available, impact analysis of changing requirements becomes heuristic.
 - Technologies are responsible for introducing few defects. There are many defects introduced due to browsers, platforms, databases etc. people do not read and understand release notes, and consequences of failure are attributed to technologies.
 - Customer may not be aware of all requirements, and the ideas develop as the product is used.

I.39 Explain the processes related to software quality.

OR

Explain the relationship between vision, missions, policies, objectives, strategies, goals and values.

Ans.: The figure shows the relationship between vision, missions, policies, objectives, strategies, goals and values.

1. Vision : The vision of an organization is established by the policy management. It defines in brief about what the organization wishes to achieve in the given time horizon. 'To become a billion-dollar company within 3 years' can be vision for some organization. Every organization must have a vision statement, clearly defining the ultimate aim it wishes to achieve with respect to time.

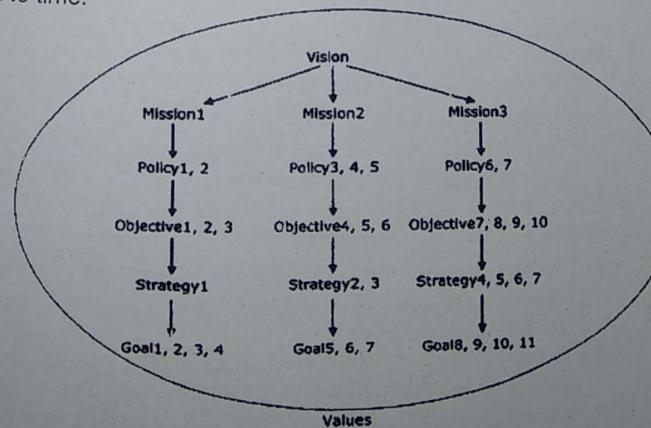


Fig.: Relationship between Vision, Mission(s), Policy(ies), Objective(s), Strategy(ies), Goal(s) and Values.

2. **Mission** : There are several initiatives defined as missions which will eventually help the organization realize its vision. Success of all these missions is essential for achieving the organization's vision. Missions may have different timespans and completion dates.
3. **Policy** : Policy statements talks about a way of doing business as defined by senior management. This statement helps employees, suppliers and customers to understand the thinking and intent of management. Examples of policies may be security policy, quality policy and human resource development policy.
4. **Objective** : Objectives define quantitatively what is meant by a successful mission. It defines an expectation from each mission and can be used to measure the success/ failure of it. Every mission must have minimum one objective and every objective must be expressed in numerals along with the time period to achieve them.
5. **Strategy** : Strategy defines the way of achieving a particular mission. These are actions required to realize the mission and way of doing things. Policy is converted into actions through strategy.
6. **Goals** : Goals define the milestones to be achieved to make the mission successful. One needs a milestone review to understand whether the progress is in proper direction or not. Goals provide these, milestone definitions.
7. **Values** : Values can be defined as the principles, or way of doing a business as perceived by the management. 'Treating customer with courtesy' can be value for an organization. The manner, in which the organization and management think and behave, is governed by the values it believes in.

Q.40 Explain generic quality management system structure for an organization.

OR

Explain the structure of quality management system.

[A-19]

Ans.: Every organization has a different quality management structure depending upon its need and circumstances. General view of quality management is defined below in a diagram :

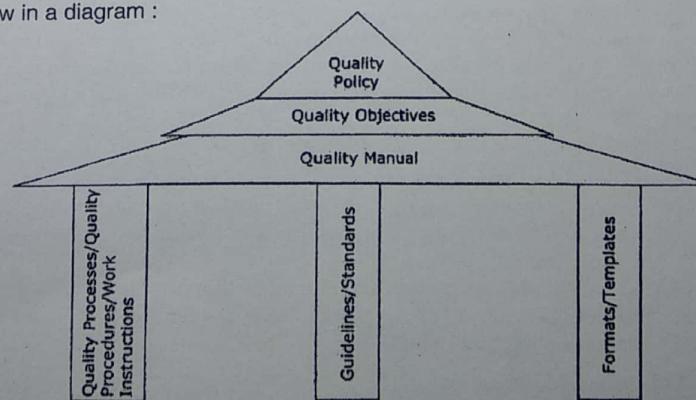


Fig.: Quality Management System of a typical organization.

Following are the three main tiers of quality management system structure :

1. 1st TIER – Quality Policy :

- (a) Quality policy sets the wish, intent and direction by the management about how activities will be conducted by the organization.
- (b) Since management is the strongest driving force in an organization, its intents are most important
- (c) It is a basic framework on which the quality temple rests.

2. 2nd TIER – Quality Objectives :

- (a) Quality objectives are the measurements established by the management to define progress and achievements in a numerical way.
- (b) An improvement in quality must be demonstrated by improvement in achievements of quality factors (test factors) in numerical terms as expected by the management.
- (c) The achievements of these objectives must be compared with planned levels expected and results and deviations must be acted upon.

3. 3rd TIER – Quality Manual :

- (a) Quality manual also termed as policy manual is establishes and publishes by the management of the organization.
- (b) It sets a framework for other process definitions and is a foundation of quality planning at organization level.

Q.41 What are the pillars of quality management system?
OR

Explain the pillars of Quality policy in details.

Ans.: The top part of the quality temple i.e. Quality policy is built upon the foundation of following pillars :

1. Quality processes/ Quality procedures / Work instructions :

- (a) Quality processes, quality procedures, work instructions, methods etc. are defined at an organization level by the functional area experts.
- (b) Organization level processes act as an umbrella , whereas project and function level processes are in the purview of these top level process definitions.
- (c) It is also defined as quality planning at project level.

2. Guidelines and Standards :

- (a) Guidelines and Standards are used by an organization's project team for achieving quality goals for the products and services delivered to the customers.
- (b) Many a times, guidelines defined by customers are termed as standards for the project, as the project team takes the recommendations by customers as mandatory.

3. Formats and Templates :

- (a) Common formats and templates are used for tracking a project, function, and department information within an organization.
- (b) It creates same understanding across the board where outputs can be compared for the projects and functions.

- (c) This also acts as a checklist to maintain consistency across the projects in the organization.
- (d) Generally templates are mandatory while formats are suggestive in nature.

**Q.42 List and explain any 5 important aspects of quality management.
(Select any 5 as per convenience)**

Ans.: Following are some important aspects of quality management :

1. Quality planning at organization level :

- (a) An organization creates quality plan at the organization level for achieving quality objectives, goals, its vision and missions.
- (b) Quality planning includes establishing missions, policies and strategies at organization level along with objectives and goals to achieve the vision.

2. Quality planning at project level :

- (a) These are generally strategic – level quality plans with details of responsibilities and actions.
- (b) Project plan must define all aspects of quality plan at project level, and may have a relation with the organization's quality planning.

3. Resource management :

- (a) An organization should use good inputs as required by quality planning so that the output of the processes match with the organization's business plans.
- (b) It includes people, machines, materials, and methods as the basic resources.

4. Customer-related processes :

Customer – related processes must be analyzed for their capability in servicing customers and achieving customer satisfaction.

5. Quality management system document and data control :

Many organizations define quality management system on the basis of some quality standards / models. Statistical process control and data management are essential for continuous improvement of processes.

6. Verification and validation :

Verification includes management reviews and technical reviews (such as code review and project plan review) whereas validation involves different kinds of testing(such as unit testing and system testing) to ensure that the work product meets the predefined acceptance criteria.

7. Software project management :

- (a) Project management is a specific skill required in leaders of projects (project manager)
- (b) Project management involves planning, organizing, staffing, directing, coordinating and controlling the project to satisfy customers by delivering the right product, on time, in the budgeted cost.

8. Software configuration management :

Software configuration management involves creating work products, maintaining them, and reviewing them by related stakeholders and updating them as and when required